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TECHNICAL REPORT

A REVIEW OF TEAM TRAINING PROBLEMS

Murray Glanzer

Robert Glaser

Contract N7onr-37008, NR-154-079

AMERICAN INSTITUTE for RESEARCH

PITTSBURGH, PENNSYLVANIA

Technical Report

A REVIEW OF TEAM TRAINING PROBLEMS

by

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Office of Naval Research
Psychological Services Division
Personnel and Training Branch

ABSTRACT

This report presents a general overview of team training procedures and problems in the Navy. It suggests some techniques for the study and improvement of team training procedures. The first part of the report deals with various alternative descriptive techniques for teams, their advantages and disadvantages. The methods that were developed to describe the activities of Navy teams are then presented. These methods are based on the consideration of the team as a communication network. This is followed by a discussion of the characteristics and problems of some typical Navy teams. The points covered include the following: characteristics of effective and ineffective teams, errors and their causes, interchangeability of men, cross-training.

Navy team training as it occurs in the shore based schools and in underway training is described. The measurement problems found in the evaluation of teams are considered and some additional methods are proposed. The importance of systematic collection of error data is stressed as a basis for measurement and systematic investigation of teams.

Some general principles developed on the basis of individual training are applied to team training. These include principles of simulation, feedback and criteria. Some general considerations in the construction of teams are also presented: number of men, special skills, and supervisory structure. In closing, some general and specific recommendations for the improvement of team training are summarized.

ACKNOWLEDGMENTS

This study would not have been possible without the cooperation of many individuals who made facilities and personnel available. We wish, therefore, to express our appreciation to the following people for their generosity in giving their time and their help: Captain C. W. Parker, Commanding Officer, Commander M. H. Buass, Commander A. F. Fischer, Lieutenant Commander W. G. Mann, and their officers and men of the Fleet Training Group and Underway Training Element; Commander F. L. Lee, Executive Officer, Fleet Air Defense Training Center, Dam Neck; Commander W. R. Crenshaw, Commanding Officer, and the officers of the Fleet Air Defense Training Center, San Diego; Lieutenant Commander W. A. Leech, Officer in Charge, and Chief Petty Officer Rickman of the CIC Training School, Dam Neck; Commander C. F. Pinkerton, Commanding Officer, and Lieutenant R. W. Baker of the Fleet Gunnery School, San Diego; Lieutenant Commander H. Moore, Officer in Charge, and the officers and men of the Gunnery School, Dam Neck.

We also wish to express our appreciation to Dr. John C. Flanagan, Director of Research, for his suggestions during the course of the project and to Mr. Alan W. Morten, Jr. for his assistance in the writing of this report.

CONTENTS

I. INTRODUCTION

Despite the importance of this area, relatively little formal knowledge exists at present concerning methods of describing and analyzing performance of teams. The lack of knowledge is due in part to the high degree of complexity posed by team problems. In the investigation of the areas of team as opposed to individual training and performance, problems appear of an entirely new order of magnitude. In some cases, the problems are simply the problems of individual performance and training multiplied by the number of people in the team. In other instances, however, new complexities enter. For example, the presence of one highly trained individual in a group of novices, seems to have a disproportionate effect in the ease of training the team.

Outline of the Report

In order to set up methods for the study of team training, a number of areas have been examined in the following sections of this report.

1. In section one, the aims of the study will be detailed. The aims are twofold. One, which may be labeled descriptive, is concerned with setting forth the present status of formal team training in the Navy. The other may be called analytic and is concerned with determining the factors that seem important in team efficiency.

2. A second section of the study will discuss the general problem of individual as opposed to team training. Some of the major deficiencies in team training will be suggested.

3. In a third section, the methods used in describing Navy teams and their advantages and disadvantages as a basis for analyzing the teams will be considered. The descriptions, by and large, stem from the notion of the team as a communication network. The problems found in these teams will also be summarized.

4. The material following this describes team training as it now stands in the Navy. Two types of training will be considered, that in the shore based schools, and that in underway training. As will be noted later, the training of teams in the Navy is a continuous affair, and much of it takes place on the ship after underway training. However, the early, and presumably most important, stages of the team's training take place during school training and underway training. The problems found in team training, particularly team training in the schools, are described, and recommendations are made concerning school training.

5. Further general information obtained in interviews concerning team training problems will be presented in section five.

6. In a sixth section, the special problems that arise in measuring team efficiency are considered. Here it is found that there are certain very definite lacks, and some of the procedures developed to compensate for these lacks are considered.

7. In section seven, suggestions are made concerning the development of techniques based on analysis of data in section five. The use of these techniques for the improvement of team training are indicated. Their limitations are also presented. A program for the development of these techniques is begun within this study.

8. In the eighth section, some general principles of team training are considered. The principles of team training are drawn primarily by analogy from individual training principles.

9. In section nine, some general principles of team construction are considered. The basis of team construction has received little attention the past. Some first attempts at setting forth such a basis are included here.

10. In section ten, general recommendations concerning team training are presented.

The Aims of the Study

The general aim of this study is to develop a rationale and a set of procedures for the study of team training. Practical applications to specific situations will be given a major emphasis, but wherever possible, general propositions concerning team training will also be considered.

The specific aims of the study are both descriptive and analytic. The descriptive aim is to give a picture of Navy teams as they now function and of the initial training of the teams. This is a necessary first step in the development of rationale and procedures and in the formulation of recommendations.

There were three descriptive jobs that were carried out:

1. The description in great detail of the activities of a number of typical Navy teams. The teams that were chosen were the following:

a. Gunnery

b. Flight Deck

c. CIC

d. Navigation and Ship Control

e. Missile Maintenance

2. The investigation of the Navy team training schools and their procedures.

3. The description of the training of teams aboard ship. This was studied through the examination of underway training. The techniques employed combinations of direct observation and interview.

The descriptions of the operating teams were designed to obtain as much information as possible about sequences of activity, interaction of responses, and possible training difficulties. The description of training procedures in both the schools and underway training was intended to obtain a general overview of training and specific problems faced within this training.

On the basis of the information collected above, investigation was made of difficulties in both the functioning and in the training of these teams. It was planned that this analysis would trace the causes of these difficulties. If there were any relations between particular aspects of training and later difficulties in functioning, these, too, were to be considered. One outcome of this description and analysis was to be practical recommendations; the other was to be some general statement of principles relating to the training and operations of teams. The general plan of the study described above follows from these aims.

II. INDIVIDUAL VERSUS TEAM TRAINING

Training of Individuals

Individual training in technical skills is universally recognized as important in the Navy. An extensive training program reflects the appreciation of this need. Although the product of this individual training is almost always organized in some form of team behavior, an equal emphasis on team training is not found. Examination of the procedures and training used with teams shows certain important deficiencies.

Deficiencies in Team Training

The deficiencies may be broken up into three main classes:

1. Lack of clearly stated principles for team training procedures. Aside from the attempt to use mock-up situations, there seems to be no explicit basis for training procedures. For example, what is the optimal sequence of problems in team training? Should the team receive its simple problem first, or should it receive alternately simple and complex problems? What is the optimal placement of lectures during the course?

2. Lack of clearly stated criteria for good teams. Is a good team one that, under good conditions and with all its personnel, runs through a performance without error every time? Or is it one that can adapt to radical changes in environment and personnel? Questions such as the latter are very infrequently raised in discussions of criteria for teams. One of the main purposes of this report is to expand the consideration of team effectiveness to include other important factors.

3. Lack of adequate measuring devices for team behavior. The usual technique of just having the team run through a simple problem is open to several complaints. A fuller treatment of this particular point will be considered below.

All in all, the area of team training is ready for further development. The reasons for its slow development are probably found in the large number of technical problems, e.g., simply measuring the team's behavior. Since, however, the finest technical training for individuals is wasted unless it is effectively organized into team behavior, it is important to develop the team training program as fully and as soon as possible.

III. DESCRIPTION OF OPERATING TEAMS

General Approach

The following procedures and techniques were used to develop descriptions of the teams. During the course of actual operations, teams were observed directly, and detailed descriptions were set up on the basis of these observations. In addition, gaps in these observations were filled in with data from interviews with team members. The descriptions were highly detailed with respect to the communications that occurred in the team, since they are crucial in determining the team's efficiency.

Problems

1. Definition of the Team

The first problem found in describing teams, concerns the definition of the team. How many of the people present during the course of an activity should be considered members of the team? Should a certain group be considered one team or two teams, etc.? This question of the boundaries of the team, or the membership of the team, arises in a number of instances below. For example, in the group called Navigation and Ship Control team, there are strong arguments for considering the team one, or two, or even more separate teams. The same consideration arises in deciding whether a particular man is a member of the team or not. One possibility is to use a criterion of interaction in deciding whether a man or group of men should be considered team members. Interaction refers to any passage of communications or materials. A man would be considered a member of the group with which he interacts more than a given amount. This is, however, not wholly satisfactory. One reason is that it is difficult to record all of the important interaction that takes place in a team. For example, supervisors in a team may not display much overt activity, although they have an important function in the team. Using a criterion of interaction, i.e., amount of overt activity in interaction, might to lead to the conclusion that the supervisors are not team members.

2. Selection of Situations

Another general problem concerns the selection of situations in which to examine the activity of the team. A team is not necessarily a stable unit. The team's composition and distributions of personnel may vary during different tasks or at different times. For example, the team working in CIC during surface plot is a very different organization

from the same team during general quarters. Their behavior and interaction of personnel is very different despite the considerable overlap of personnel.

3. Unit of Activity

There are also a number of problems in the mechanics of description. One of these concerns the unit of activity to be used. There are two possible alternatives. One is to use a time unit and measure precisely the amount of activity and its sequence in the team. This is a costly procedure. Another possibility is to divide the stream of behavior into distinct acts and to analyze the data in terms of an act unit. This alternative has the following difficulty. An act is an extremely variable unit, in some cases requiring no more than a second; in some cases requiring several minutes.

4. Length of Job

Another problem is concerned with the length of the job used to describe the team's activity. In sampling the activity of the team, should random time samples, or should the performance of complete jobs be taken? The beginning and end of a job for a team are not very clear. Should a job be defined as starting when the team goes on duty, or when a new problem arises?

5. Cyclical and Routine Activity

Problems arise in the weights to be assigned to certain sequences of activity. It is frequently found that there are repetitive cycles of activity in the operations of a team. Should these be counted as frequently as they occur or only once? Closely related to this is the question of the role to be assigned to periods of routine, minimal activity as opposed to periods of peak activity. Since there may be many more of the former, a complete history of the team's activity will weight those portions heavily. The periods of peak activity may, however, be the much more important periods. Should they be weighed more heavily? The answer to these and many others, depends in good part on the type of information that the team descriptions will be related to. These relationships are now in the process of first estimation.

Descriptive Procedures

1. Teams were defined in terms of interaction. It was found that the teams thus defined corresponded closely to the customary Navy definitions of the teams.

2. Typical situations for each team were selected. In cases in which the team differed greatly in composition and procedure on different tasks, the two situations were handled separately, e.g., CIC.

3. The unit of description adopted was an act unit. As was noted earlier, acts may vary considerably in the amount of time they take. These disparities in the length of "acts" are aggravated by the fact that in some cases it is necessary to represent continuous functions that occur over a long period of time by a single act. Exact time measurement, however, is unwarranted at this stage. As the structure of relationships in the area become clearer, refinements in measurement can be introduced where they will be fruitful.

4. Jobs were defined in terms of completion of a specific task. The alternative of random sampling of complete and exhaustive histories for the teams would be highly uneconomical at this stage.

5. Cyclical and routine activities were counted only once to avoid arbitrary weighting.

One of the most important characteristics of efficient team behavior is the adequacy of communication between team members. It was decided, therefore, to organize these acts into communication network terms. In order to have a unitary system, the term communication included not only the transmission of messages, but also the presentation of any stimulus to another team member. Thus, the handing of a piece of equipment without a word to another team member, if it acted as a signal for a subsequent act by that member, was classified as a communication.

In order to emphasize the communications and interrelationships between team members, the following descriptive format was adopted:

Team performance is analyzed into the distinct acts carried out by the members. Each act, in turn, is broken down into the following elements:

input - the signals or stimuli that elicit the act

process - the behavior carried out by the member

output - the signals or stimuli given off during the act.

Thus, if a member sees a target, determines its range and bearing, and then shouts out his result, the entire act would be described as follows. (Input, process and output are abbreviated I, P, and O, respectively.)

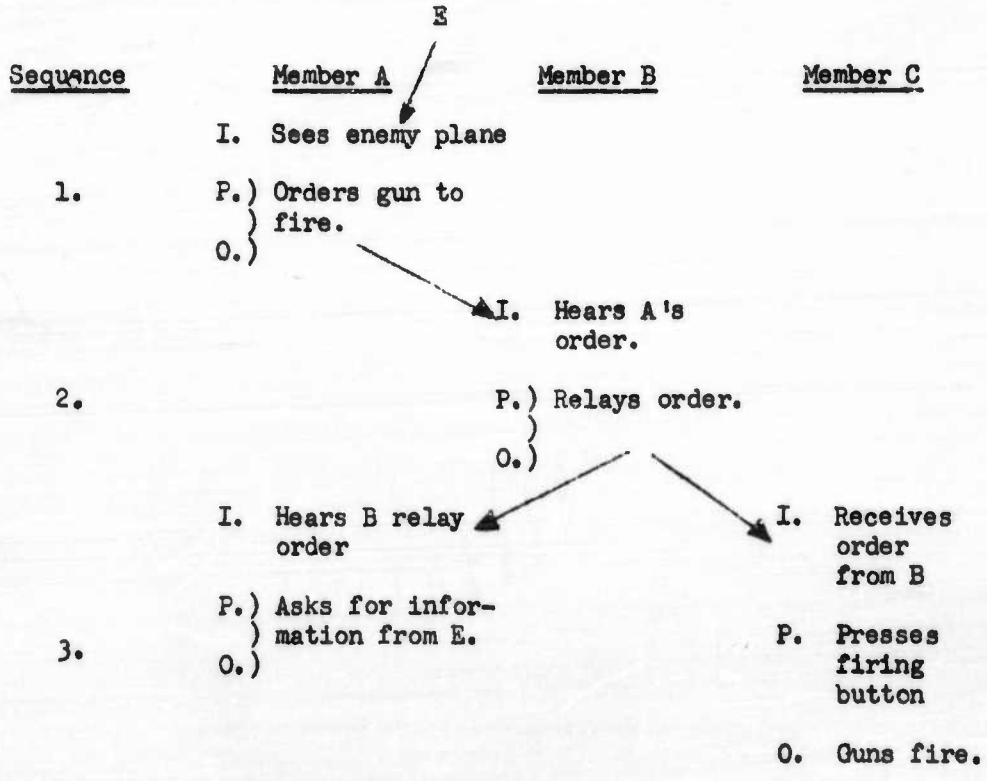
I. Observes scope

P. Determines range and bearing

O. Shouts range and bearing.

In certain cases the process and output are indistinguishable. There, the process and output will be bracketed and treated as one, e.g., Member B, below.

The description was furthermore designed to show the sequential character of the team's activity. The team descriptions are, therefore, organized in the following manner in order to depict time flow. The acts of each individual are described in sequence within a column for each individual. An example is given below:



The arrows indicate the sequence of acts and the dependence of inputs on previous outputs. For example, A sends orders to B, and then B relays to C, above.

Since in many instances the initiation of activity comes from outside the team, the symbol E is used in the description to indicate external or environmental inputs.

An arrow from an E indicates a stimulus or input from some point external to the team. For example, Member A receives an input from the environment when he sees the enemy aircraft.

Classification of Acts

In addition to description of each act, an attempt was made to categorize them into one or more of the following classes:

1. Observation (O) - acts primarily concerned with obtaining information.

2. Relay (R) - the simple transmission of messages from one team member to another or to other teams.

3. Manipulation (M) - the handling and movement of material objects, e.g., tools, controls, crates.

4. Decision (D) - the determination of a course of action, usually on the basis of several sources of information.

5. Computing (C) - the use of calculations to convert information to a different form, e.g., computing speed from time and distance information.

6. Supervising (S) - the watching and, if necessary, the correction of behavior within the team.

One or more of the letters in parentheses (O, R, M, D, C, S) are placed next to each act by a team member, indicating the classifications that have been judged to fit the acts. For example:

	I. Sees target on scope
O, C	P. Tracks target; determines speed
	O. Gives information to Member X.

Certain classes listed above imply the sending of messages, e.g., decision, observation. If, however, an act is classified as a decision or observation, it is not then also classified as a relay. Only those acts are classified as "relay" that are pure relaying functions.

Uses

Once these descriptions are set up in this fashion, their possible uses may be considered. One advantage of the description is that it gives in a fixed form a representation of the team's behavior. It is, in a sense, a time and motion study of an entire team. Although time and motion studies have been done for individuals, the approach has not, in general, been used with teams.

1. Relationship of Team Characteristics to Errors

The descriptions may be examined for characteristics that make for errors in the team. Hypotheses can be formed and then checked against the actual occurences of errors.

The following types of relationships were considered:

a. the amount of activity occurring simultaneously in the team, as related to the probability of errors at particular times.

b. the amount of activity carried out successively by a given position as related to the probability of error in that position.

c. the amount of simultaneous activity as related to the need for supervisors.

d. the pattern of activity (whether steady or sporadic) as related to the teams susceptibility to fatigue.

It is also possible to work in the opposite direction. Given the errors, it may be possible to discover in the description of the team those characteristics that are most likely at fault. In either case there is need of some record of errors and the frequency of these errors for the various teams.

2. Categories of Activity

Another possible use of the descriptions is in an analysis of the types of activity that go on in the team. One scheme of analysis has been indicated above in the categorization of the acts of the team. The distribution of the activity of the team in these categories can be related to special training problems and to difficulties in functioning. Similarly, it is possible to relate the characteristics of the individual to the possibility and nature of errors.

3. Other Analyses

There are other analytic schemes that could be used. Another possibly fruitful breakdown might be one that separates communicative (input or output) from noncommunicative activity (process) in the team. Presumably a team in which there is a high ratio of communicative to noncommunicative acts would be one in which the training of the team as a unit is extremely important; whereas a team in which the acts are primarily of a noncommunicative nature, would be one in which individual training may be more desirable. Thus, for example, the amount of time spent on the process category as opposed to the output category could be measured for all team members. Team members who have a high process to output ratio, could, furthermore, be distinguished from those whose ratio is low. Different amounts of individual training for these groups might be recommended.

4. Team Structure

The descriptions of the team's activity can be used to start an investigation of various structural characteristics of the team and to relate these characteristics to the performance during training and operations.

The first step is to develop the concepts of structure. The second step is to devise adequate measures for these concepts, and the final step is to relate these to the behavior of the group. An example of a hypothesis in this area would be that the higher the degree of centralization in the team, the less likely errors would be in the team. This hypothesis would be tested by relating the structural characteristics to the probability of error.*

*This approach was adopted, and a number of different characteristics or dimensions were considered. A set of dimensions, on which the teams could be measured, was constructed. A list of dimensions and suggestions for their measurement are included in a separate report: Glaser, R., Glanzer, M., & Morten, A. W., Jr. A Study of Some Dimensions of Team Performance, American Institute for Research, September 1955. Here again it is desirable to have error data and other data concerning the behavior of the team to correlate with these measures.

Cautions Concerning Use of Team Descriptions

There are certain important points to be noted in interpreting the team descriptions. They cannot, detailed though they are, include all of the important activities of the team. They give an adequate picture of the performance of the team on a routine job. However, some of the crucial incidents are not routine. For example, after completion of the descriptions of these teams, it seemed that many of the jobs did not use the high degree of skill and training required of the team members. Further questioning revealed, however, that the high technical skill demanded was not displayed in the course of routine tasks, but was necessary in case trouble arose. Since these trouble situations do not occur with great frequency, a misleading inference concerning the requirements of the team could be made. It should be recommended, therefore, that the sampling of a team's activity used in developing descriptions of the team and estimates of importance of various teams should be expanded to include non-representative and relatively infrequent occurrences.

Characteristics of Effective and Ineffective Teams

Additional data are required if the team descriptions are to be related to characteristics such as the team's efficiency. For this reason, the instructors at the fleet training schools and in underway training were interviewed to discover the characteristics of both good and poor teams, and factors that underlie these differences. Some of the questions that were asked relating to these points were the following:

1. "For teams observed during training, think of the last time you observed an effective team. When was this? What did this team do to indicate that it was an effective team? Mention as many specific instances as you can. What were the reasons for the effectiveness of the team?"

2. "For teams observed during training, think of the last time you observed an ineffective team. When was this? What did this team do to indicate that it was an ineffective team? Mention as many specific instances as you can. What were the reasons for the ineffectiveness of the team?"

The answers to these questions were classified into two main categories. One class concerned the team as a unit; the other concerned individuals in a team. Team answers were those which applied to the functioning of the team as a whole or to all or most of the members without regard to specific jobs or stations. Individual answers were those which applied to specific jobs. Within these two main classes the answers were further divided into answers concerned with product, behavior or cause:

1. Product - observations concerning the outcome or goal of performance.

2. Behavior - observations concerning the specific acts of individuals during the course of the job.

3. Cause - observations concerning events or conditions prior to the activity of the team. Cause usually concerns such areas as instruction, motivation and administration.

Tables containing summaries of the responses given to the questions are included in Appendix I.

Since the information was obtained in training situations, it contains information peculiar to the schools and underway training. For example, in many of the answers concerning causes of poor behavior of teams in training, references were made to the methods used in selecting personnel for the schools, and complaints were registered about the inclusion of "short-timers." Where these answers seemed to be characteristic of the particular school, they were not included in the tables. Reference to them is made, however, in the consideration of special training problems.

One of the points noticed was a considerable difference in the CIC teams and the Gunnery teams. Many of the important characteristics listed for the CIC team fall under team product; whereas, relatively few of those characteristics mentioned for the Gunnery team fell under this category. This may reflect a difference in the complexity of the team's product. Similarly, there was a great deal of information concerning individual position in the Gunnery team; whereas, relatively little information of this nature appeared concerning the CIC teams. This may reflect in part the greater complexity of organization in the CIC team. Errors might be more difficult to localize. It may also reflect differences in the training level of the two teams. The CIC team members have a much more extensive background of previous training than do the Gunnery team members and, thus, might be expected to show fewer individual errors.

Information was also gathered concerning difficulties at specific positions within the teams. This was to elaborate on the information listed in the tables in Appendix I. It was also to be a basis for relating difficulties at particular positions with characteristics of these positions as derived from the team description. For example, it was possible that individuals with a large number of links with other individuals in the team would be likely to make errors.

The following questions were asked of the instructors at the team training schools and underway training:

1. "Are there any positions in the team at which many errors occur during training? Which are they?"

2. "What do you think causes these errors?"

The respondents were few, varying from four to eleven for a given team. They were, however, experts with wide experience in this area. At this point the data do not warrant more than a rough ranking of the positions with respect to likeliness to make errors. There is, however, some useful information concerning specific positions obtainable in this fashion.

In the CIC teams the most frequently mentioned positions were those of the radio and sound powered telephone talkers. These are mentioned much more frequently than almost all the other positions in the team together. Next most frequently mentioned is the maneuvering board operator; then the surface plotter; and then both the evaluator and the CIC officer. Almost all the other positions in the team are mentioned once by the interviewees. The ranks of these positions bear out the idea that much of the trouble in the training of the CIC team centers on the communication procedures. The evaluator does not rank high among the error prone positions, although he was mentioned frequently as one of the factors in the ineffectiveness of the CIC team. This may be due to the fact that specific errors were not the key to the evaluator's difficulties. Ineffectiveness is usually related to lack of recommendations by the evaluator.

The answers concerning the Gunnery team indicate that the positions most likely to show up errors are the pointer, the trainer and the fuze setter in the gun mount. Next most likely is the sight setter in the gun mount and the computer operator in the plotting room. Less frequently mentioned are the loaders, the director control officer and the spot knob operator. The pointer, trainer, fuze setter and sight setter seem to have this error in common - inability to read the dials properly. This may indicate a need for either a change in training emphasis or an equipment change.

IV. INTRODUCTION TO TEAM TRAINING

Introduction

In order to view Navy team training, the shore based schools were first examined. Formal training of teams is centered in the shore based schools. Team training in a larger sense is, however, not restricted to these schools. It continues through underway training and beyond that. The team training that takes place outside the schools is, however, much more difficult to evaluate since it occurs in much more variable and complex situations aboard ship.

Questions were asked concerning the characteristics of the teams themselves, techniques, major difficulties, and suggestions for correction of these difficulties in team training. Most of the material concerning the teams themselves has been summarized in the preceding section.

The Schools

In order to follow the CIC and Gunnery teams through their training, the schools concerned with training of those teams were selected for study. On this basis Fleet Gunnery Schools and Fleet Air Defense Training Centers were studied on both the East and the West coast. In addition to this, the team training course for Regulus Guided Missile teams also was studied. The material drawn from the latter work will, however, be included in a separate report on the Regulus missile.*

The CIC School is, in general, devoted primarily to advanced team training. (Its mission is stated to be the providing of facilities for training officers and enlisted men as a coordinated team. It is assumed that the trainees have received basic training elsewhere in the operational use of electronic equipment and in the function of CIC.) The course offered in this type of school can be adapted to teams from a wide range of ships, from auxiliary vessels to carriers. The teams sent to the schools are selected by the commanding officer of the ship, or officers under him. (In the case of CIC, the other officers would be either the CIC officer or the operations officer.) There are no published minimum requirements for the selection of this team other than that the trainees should be members of the ship's general quarter CIC team. This implies that the team members should

*Morten, A. W., Jr., & Glanzer, M. Individual and Team Factors in the Check-Out and Launching of the Regulus Guided Missile, American Institute for Research, September 1955.

be radar men or radar strikers and should have a familiarity with the fundamentals of CIC operation, such as, operating radar, plotting, telephone and communication procedures, status board keeping. The school may request a minimum of ten to sixteen men.

The request for qualified men and for groups of a certain minimum size are not usually met. This is related to the other demands for personnel that are usually urgent at the time that the ship is sending team members to school. Special attention probably should be paid to the school's published requirements. There were strong indications that considerable difficulties in team training arise from the following:

1. Incomplete groups received
2. Personnel received who do not have the prerequisite training or experience
3. Short-timers sent who present problems of motivation and morale
4. Lack of experienced personnel accompanying team to counterbalance the usual low level of training of the team as a whole
5. Personnel sent merely to fill quotas, in some cases personnel who have not been in CIC teams and who will not be assigned to them after their completion of training.

It may be recommended that the groups sent to the school be restricted to trained and complete units. The training school is not designed or equipped to give instruction in basic techniques; it can only review these techniques.

The course of training may be divided into two distinct parts. The first part consists of lectures on air control, equipment, communications, electronics, etc. The second part of the course consists primarily of work on mock-up situations. Mock-up problems are usually prefaced by an orientation lecture on the problem. The problem can be stopped at any time and started over.

The specific form of the problems is adjusted to the ship from which the team comes. Thus, a group from a destroyer will go through a different set of problems than a group from a carrier. The mock-up problems consist of problems such as radar navigation, formation maneuvers, naval gun support, torpedo attack, etc. During the mock-up problems the ratio of instructors to students may be extremely high.

In certain cases there may be one instructor to every two students. This, of course, is highly favorable for effective learning.

A team goes through as a group and is then returned to its ship. The team is never required to repeat a course because it is unsatisfactory. In other words, the school has relatively little control over the trainees as far as making sure that it reaches a given level of proficiency. Examinations are given, and at times ratings of the individual trainees are given. This is, however, not an official or widespread practice at this time. One of the schools is working towards setting up a system of grades on the mock-up problems. There is usually no general test at the end of the entire course. The sending of information to the schools from the fleet concerning the team returned from training is not a usual practice. Occassionally, letters from the commanding officer are sent. The school does obtain information concerning the performance of CIC teams from two sources:

1. Information from underway training

2. Information from the debriefing that takes place when a ship returns from fleet operations.

Fleet Gunnery Schools were also visited. In particular, the course of training of the five-inch twin-gun mount team was studied. The courses devoted to this specific gun mount are the following:

1. A complete course taking approximately a week in which it is assumed that the trainees know nothing about the gun

2. A two-day refresher course.

Director crews and gun crews are trained separately, but fire together. In the longer course there may be two firings of the gun, in the refresher course, one firing. The trainees are given lectures, drills, and firing exercises. There are also movies, demonstrations and discussions. Many of the points brought out in interviews with the instructors of the CIC schools came up again in interviews with the gunnery school instructors.

The mission of the Fleet Gunnery School is to conduct training for officers and enlisted personnel in the control and operation of gun and torpedo mounts, and also gun and torpedo batteries. The operation of the gun mounts and the gun fire control systems is a team operation. The training in these team operations requires, however, less technical background than that of the CIC schools. A crew in which most members have had previous experience in gunnery is acceptable for this course. It is desired, however, that the individuals

sent be gun crew members. The school again usually requests a minimum number of personnel and would also desire certain ratings. Again, these requests are not usually met. Most of the difficulties found in CIC training are also found here. The following points may be mentioned:

1. Crews sent are frequently too small for efficient training as a unit

2. Crews often contain personnel who are not gun crew members and who will not be returned to gun crews.

Again, as in the case of the CIC school, the team is sent through as a unit and whether it performs satisfactorily or not, it is returned at the end of a specified time to the ship. If the crew or its members are very poor, this may be mentioned in a form sent out to the ship. Oral and written tests may be given. In general, the school does not receive adequate information from the fleet concerning the teams it has trained.

General Considerations Concerning the Schools

There are two general considerations raised by the examination of the training schools. One of these concerns the importance of feedback for a school. The other concerns the composition of the group sent for training.

1. Feedback

Feedback from the fleet to a training installation should concern two areas:

a. The performance of the team trained

b. The actual operating situation for which the team is being trained.

The first of these is related to certain other problems mentioned elsewhere, namely, the adequacy of measures during training and the appropriateness of selection of personnel, e.g., whether the personnel trained go into the ship's team. It is, however, important for the staff of the school to get information as to how well the good teams do and how well the poor teams do in actual fleet operation. The closeness of relationship between training and fleet performance should be known.

As for the second type of feedback, the divergence of the operational situation and the training situation can very

easily occur owing to the widespread and continual equipment change. Since this is so, a great effort should be made to keep the training and actual situation as close as possible. The school may be either ahead of the fleet or lag behind it on both equipment and procedures. This divergence causes both waste of training time and an attendant lowering of morale.

It might be suggested, therefore, that a formal procedure be established to insure rapid feedback from the fleet on both the performance of the team trained and the status of fleet operations and equipment.

2. The Leavening Problem

A general problem of the schools concerns the absence of well-trained petty officers in the teams that enter training. The general feeling seems to be that a team that is leavened with a few highly trained, responsible personnel makes the work of instruction immeasurably easier and more effective. The logic behind this is clear. The presence of the trained petty officers actually adds to the instructional staff of the school. It adds, moreover, an instructor who is better acquainted with the special characteristics of the ship and the special characteristics of the team members than any of the instructors in the school itself. It adds, furthermore, an instructor who can put in time in detailed individual instruction.

An interesting problem that arises here is the degree of leavening as related to the economy of training the team. As far as the ship is concerned, it is advantageous to send as few petty officers with the team as possible since these men are usually in demand at this time for work on equipment. However, this may be uneconomical in the long run if it handicaps badly the training of its crew.

As far as the school is concerned, the relationship between the degree of leavening and the efficiency of training is not clear. Presumably there should be some optimal ratio of highly trained to relatively untrained personnel in the team. What this is cannot be estimated at present. It does open up a question that can be studied experimentally.

A Specific Training Problem in Gunnery: Freezing

A problem that is mentioned rather frequently in the Gunnery school is the problem of freezing. It seems that the trainees when first facing an actual firing situation will become very frightened, will be unable to move, and will, in general, show maladaptive and highly rigid behavior. Another thing noted by the instructors is the difficulty in predicting the individuals who will freeze during firing.

The interviews with the instructors indicate that the actual firing situation adds two factors to the training situation; one is the noise; the other is the greater danger. One hypothesis is that freezing is brought out by the noise, the danger and some effect of the combination of the two of them.

Psychological considerations indicate that the effect of either of these could be minimized by adapting the trainees to these factors before they meet them in actual firing. The danger, of course, cannot be very sensibly introduced in the training situation. The noise, however, can. It may be proposed, therefore, to introduce slight amounts of noise early in the training course and then increase the amount of noise presented until the noise level approaches that of actual firing. If this procedure succeeds in adapting the men to the noise, then the contribution of the noise alone and the noise in combination with danger may be eliminated as factors that give rise to freezing.

The practical requirements of this procedure are simple. Recordings of noise could easily be used during, for example, loading drills. The only other consideration is an economic one. Assuming that the program is successful, will it cost more to rearrange training, or will it cost more to permit a certain percent of training investment to go to waste because trainees cannot function in actual firing situations? The answer to this depends on the estimates of these two costs.

Underway Training

The examination of the team training extended beyond the first stage of school training to the training that occurs at a subsequent stage - underway training. There were two reasons for this. One was to see how the team was trained beyond the formal stage. The other was to examine possible sources of error data. The focus was on those parts of underway training concerned with Gunnery, Navigation and Ship Control, CIC.

A Navy cruiser or destroyer goes through a regular two year cycle. The cycle may be considered to start with ship's commissioning or entry into the Navy yard for overhaul. The cycle is completed with the return of the ship to the Navy yard for major overhaul two years later.

During overhaul, which takes three months, a great number of things have to be accomplished, including the following. Damaged and inoperative equipment has to be repaired and modifications in equipment incorporated. Standard maintenance procedures have to be carried out. Losses due to separation, etc., have to be made up. The organization is checked to see that all bills are filled and that all stations are manned. Personnel have to be sent on leave, and as many as possible sent to school. (The schools include those concerned with team training.) The assignment of personnel during this period gives rise to considerable conflict. It may be necessary to send the same man on leave, to school and to work on maintenance and overhaul during the same period of time.

At the end of the shipyard period an equipment inspection is carried out. The shipyard period is followed by a week in which the ship, which may be anchored, or at a buoy or a tender, is made ready. During this week ammunition, fuel and stores are loaded, and the crew is drilled repetitively.

Once the ship arrives at the Fleet Training Group and reports in, it is sent to a naval station pier or buoy for one week. During this week various sections of the Fleet Training Group send men out to evaluate the ship's readiness for training. At the beginning of the week, the Fleet Training Group personnel point out deficiencies in equipment, manuals, etc. During this week, various members of the ship's complement receive in-port training. Depending on their state of training, they are sent as individuals or as groups to various schools. Officers are also sent to schools during this period of time. The best maintenance men, however, would ordinarily not be sent to school during this time, but would be occupied with preparing equipment for operation. At the end of this week, the ship is given a training readiness battle problem. This is a simple problem, usually taking no longer than thirty minutes, which involves various casualties, and is used to test the over-all coordination of the ship's personnel. An evaluation of the ship is made on the basis of the equipment checks and the performance during the training readiness battle problem. Complete copies of everything said by the evaluator go to the ship. A critique is held in the ward room, and each evaluator reports his findings, mentioning only what is wrong.

On the basis of the evaluations, the emphases in training are determined. The training school personnel are distributed during training according to estimates of the needs of the ship. Following this preliminary evaluation, the ship spends a week at sea, during which time it carries out various exercises.

Data Sources in Underway Training

Underway training may be considered less useful for the direct study of training processes than the school training situation because it is highly complex. Equipment difficulty, time pressures, wide differences in the background of personnel, all complicate the picture of training during this period. The personnel undergoing underway training also vary considerably in their previous training. The underway training situation is, however, extremely important because it gives rise to a large body of data concerning the teams. Each training supervisor sends in frequent reports on the team he is concerned with. These reports are kept on file and form the basis of general over-all reports concerning the team and the ship. Thus, at the underway training installations, a huge body of data is collected and processed. Advantage should be taken of this material for the future study of teams.

The material as it is gathered now, is not specifically designed for the purposes of this study. Examination of this material suggests, however, two possible procedures. One is to work with the material as it now stands in the files of the Fleet Training Group, using expert opinion to indicate specific information. For example, much of the material collected is of a general nature. The interest here would be, in the specific causes of an error. An expert can, in reading over the material furnished, give with a fairly high degree of certainty the specifics of the case. Such a procedure (using the files of the Fleet Training Group) has been carried out to determine the characteristics of the boatswain's mate's job. The other procedure possible is to adapt data collection forms used by the ship's riders to obtain information on points of special interest. The changes introduced need not be major. At present, the Fleet Training Group makes use of a large number of observation forms and check lists. Changes could easily be introduced in these to obtain specific information. In this way a current body of information could be set up concerning any team of importance in the Navy. It is possible that underway training can be used to give the error data considered in Section III.

V. GENERAL INFORMATION FROM INTERVIEWS

A considerable amount of information concerning training and team operation was obtained from interviews with the instructors at both the team training schools and underway training. Some of the main points brought out in these interviews will be summarized below.

Recommendations

The instructors at the schools were asked about recommendations concerning possible improvements in the organization of the teams. The questions that were asked were the following:

1. "What recommendations would you make for the improvement of this team's efficiency?"

2. "What specific changes in teams might improve their operation in the fleet?"

Many of the recommendations follow quite directly from the information listed under characteristics of effective and ineffective teams. An examination of the answers indicates that there were again two main classes of recommendations. One concerned the teams, and the other concerned the individuals. Again, within each of these classes a further breakdown was possible. This was into training, motivation, and administration. In all the teams reaching underway training, more training was considered necessary for both individuals and teams.

Discovery of Errors

An important point in analyzing the errors made by the team is the ease of discovering the errors made by the team members. Some errors are easy to notice, others are difficult.

The question asked about errors was the following: "Are there any errors that are particularly difficult to discover as the team works?" The instructors for the CIC and for the Gun Mount indicated the existence of a large number of such errors. In the case of the Gun Mount the errors that are hard to trace are the following:

1. Pointer and trainer not actually on target

2. The fuze setters not reading pointers correctly. The errors made by the fuze setter are mentioned several times.

In the case of CIC, the errors that are hard to trace occur primarily in plotting and in communication procedures. They are the following:

1. Faulty plotting on DRT and maneuvering board

2. Lack of accurate reproduction of information received on sound powered phones

3. Evaluator errors

4. Faulty range and bearing reports by radar operators.

Errors that are difficult to discover are important for both training and evaluation procedures. Their presence makes training less efficient and evaluation of individuals in the team less accurate.

Correction of Errors

The question that was asked was the following:

"In training, if a trainee makes an error, how is he informed of it?"

At all training installations, the instructors were aware that they should indicate the occurrence of an error as soon as possible after the incorrect act. They also indicated a flexibility in handling this policy of speedy correction. For example, in the CIC schools they indicated that under certain circumstances it might be more desirable to have the trainee discover his error by himself by allowing the effects of the error to be felt. The procedure was also modified according to the rank of the man who made the error. In cases of high ranking team members, the instructors indicated a preference for correction in private after the completion of the problem.

Cross-Training

There are several reasons that dictate an interest in interchangeability. One of these is the efficiency of the team. It may be assumed that each member of an interacting team will perform better the more he knows about the requirements of the other team members with whom he communicates. Another concerns the adaptability of the team to changes in personnel. A third reason is one of economy. With high fluctuations in personnel and with shortages in personnel, it is desirable to have a man know his own job and as many other jobs as possible. A fourth reason is concerned with the preparation of personnel for supervisory positions. As indicated below, there is a strong belief that knowledge about the jobs is crucial in determining supervisory efficiency. Presumably, better supervisors would be produced by a system that contains a high degree of cross-information.

Cross-training may result in either cross-information or interchangeability of positions. Cross-information refers to knowledge about another man's job in the team. Interchangeability refers to the ability to do the job.

The questions that were asked were the following:

1. "How interchangeable are the men in a team?"

2. "How much do team members have to know about each other's jobs?"

There were certain clear differences that appeared in comparing the results for different teams. The Gun crew, for example, seemed to have fewer cross-training needs than did the Navigation crew. This may relate to the difference in the interaction of the teams. In the Navigation team messages pass back and forth between members much more than in the Gun Mount crew. The Gun Mount crew's messages are much more uni-directional. It may also relate to the difference in amount of training given the team members.

A major source of difficulty in eliciting clear information concerning interchangeability and cross-information was in distinguishing the various degrees of necessity of cross-training and also distinguishing what should be and what actually occurs in Navy teams. There was a feeling that ideally every man in the team should know everything about every other job. Although this might be desirable, it certainly is an unrealistic and probably an uneconomical goal. Even when the respondent answered in terms of the actual state of affairs in Navy teams, the answers varied widely, due in part, to considerable variation in the teams and in part, probably, to variation in the judge's standards.

There seems to be a need for clarifying the cross-training requirements of the teams. The only promising method that thus far devised for both setting up standards of interchangeability and for measuring interchangeability, is the method of subtraction discussed in Section VII.

In considering the ideal degree of interchangeability, various types of answers were given by the instructors. One idea was that personnel in supervisory positions should be able to do all of the jobs of the people they supervised. It may be questioned, however, whether such positions as the evaluators in CIC teams should be required to know all of the tasks carried out in the team. It might be claimed that the supervisory function is a separate function distinct from the top administrative position in the group and that these two types of positions have different cross-training and

interchangeability requirements. The supervisor should be able to do every job in the team well; the administrator should not. There does seem to be specialization along these lines within the Navy teams.

Another idea may be that all people who are in close interaction with each other should be cross-trained and interchangeable. The variation of the answers on the amount of interchangeability and the location of interchangeable positions in the teams does not permit a test of this hypothesis in the data.

In conclusion, it must be noted that discovering the cross-training requirements of a team is a complex task. The answers obtained thus far merely give a first indication of the needs in this area. Work with more objective instruments is clearly needed.

VI. MEASUREMENT OF TEAM EFFICIENCY

Measures of the outcome of training are important for two reasons. They indicate the degree to which the trainee is proficient in the task. They also indicate whether the training procedures are adequate. These reasons have been recognized in the very rapid growth of measurement techniques applied to the outcome of individual training. However, the area of measures of team efficiency is in general a neglected one.

During both school and underway training, the instructors and evaluators reach a consensus of opinion concerning the teams. The methods for obtaining data and reaching a consensus are not, however, completely formalized or objective.

In the case of certain schools, there are many opportunities to measure the performance of the team that are not incorporated into any formal test program. The team as a team is tested perhaps once at the end of training. This test will usually consist of a single problem. For example, the last day of training may consist of the firing or simulated firing of the gun by the full team. In this case, it should be noted furthermore, that the test is not used to evaluate the team in the sense that the team passes or fails on the basis of its performance.

The scarcity of team measures may be related to two things:

1. Measures of team efficiency are not used for anything. They do not determine whether a group passes or fails. This applies most directly to the case of the training schools.

2. A great amount of time is required to test a team.

With respect to the second factor, testing a group usually requires a considerable period of time. As a result of this, the test is usually restricted to one problem. If one compares this with the testing of individuals, it becomes apparent that group tests are essentially one item tests. The one item test has a major difficulty - that of low reliability. It would be expected that a single item test may give a grade that can deviate markedly from the team's true performance. There is another difficulty in the one item test that reduces its validity directly, and that is, that it is used frequently with situations that are easy to construct. Situations that are easy to construct, however, may be only slightly related to the crucial situations that determine the efficiency of the team.

A test should be essentially a sample of the required behavior on the part of the team. There is no assurance in the methods of test construction for teams that the sample taken gives a valid

measure. For example, the performance of a team to specific types of stress may be of crucial importance in determining the long run efficiency of the team. More specifically, the performance of the team under conditions of high fatigue may be of crucial importance. Under ordinary testing situations, these conditions may not be tapped.

This point was raised with the work of other investigations on teams in mind. The importance of such conditions in measuring the efficiency of a team is reflected in the procedures used with air defense centers of testing to breakdown, that is, measuring the performance of a team under very heavy loads.

There are of course, certain practical problems in constructing tests for teams that have more than one item and are generally satisfactory. The first and most important of these, as noted above, is probably the length of time required by a team test. The purpose here is primarily to point out that this lack exists. There is, at present, no way of systematically estimating the efficiency of the team as a whole except by observation of the team in actual operations. The instructors at the schools are aware of this lack as reflected in statements that it is hard to know whether a team is really good.

There is one technique frequently used to compensate for the one item character of team tests. This is multiple scoring of individuals within the team. Since each one of them usually carries out several acts, it is possible to derive a score or rating based on several acts for each individual. This is an important supportive technique in measuring the team's efficiency. It can, however, be extremely misleading if taken alone, since it is quite possible to have individual members of a team do well and yet have the team function poorly as a unit.

VII. DEVELOPMENT OF ADDITIONAL TECHNIQUES FOR STUDY OF TEAMS

Use of Error Data

In the light of the measurement and training problems indicated above, it is desirable to develop reliable sources of data concerning the error behavior of operating teams. There are several general uses to which error data can be put.

1. Measurement Procedures

   The first of these, is in the development of measuring instruments and scales for the evaluation of teams. A major problem during the initial investigation of teams is to know what characteristics are important in discriminating good from poor teams. Error data indicates the points on which the evaluator should focus.

2. Diagnosis

   The error data can also be used to diagnose team problems and suggest possible solutions for these problems by localizing error sources. It should be possible to say something about the nature of the team's difficulty, rather than that it was just good or bad.

3. Relationship to Team Characteristics

   Error data can, furthermore, be used to state something more general concerning teams. One of the attempts outlined on a companion report* has been to develop measures of important characteristics of the team and its communication structure. It is hoped, of course, that these measures will be meaningful in the sense that they are related to characteristics of the team's performance. It is suggested here, that the test of these measures will lie in their relationship to the error data of the team. Let it be assumed, for example, that a satisfactory measure of some structural characteristic in a team has been constructed. The next step might be to test whether teams that differ in this structural characteristic differ in the amount, type and locus of errors that they show. Given error data of the type discussed here, this could be readily done.

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*Glaser, R., Glanzer, M., & Morten, A. W., Jr. A Study of Some Dimensions of Team Performance, American Institute for Research, September 1955.

It should be noted that a system of error collection cannot be a static one. It must always reflect changing conditions within the operating fleet. These changes will arise from several sources:

1. There are constant equipment changes that will affect the nature and frequency of errors.

2. As the program takes effect, certain errors may be expected to disappear as a result of improved training procedures.

3. Changes in the character of fleet operations may affect the distribution of errors.

It is hoped, therefore, any collection of errors will be periodically revised so that the training and measures constructed on the basis of them are closely related to actual operating conditions.

The material in the files of the Fleet Training Group can be drawn directly to give information about the functioning or malfunctioning of the team as a whole. Interpretation can be introduced by competent, experienced investigators to relate this information to specific positions within the team. However, the information is usually not set up to give this directly. For example, the files have been used to compile data on the errors made by boatswain's mates. In the course of this work a number of difficulties were found. The person responsible for a recorded error often had to be deduced on the basis of general information concerning the team.

The general nature of the material on file at the Fleet Training Group is given in Appendix II.

New Techniques for Measurement and Analysis

Let it be assumed that situations are set up in which the efficiency of teams can be measured. What further can be done to improve these evaluation situations? It is possible to introduce certain variations in the situation which have two purposes. One is to give a fuller and more valid measure of the group's efficiency. The other purpose is to develop general information concerning the functioning of the team. There are two possible techniques for varying evaluation situations which may be used for both purposes above.

1. The Overloading Method

One method that has been developed may be labeled the overloading method. The basic idea is to present a team with successively greater and greater work loads and to relate the efficiency of performance to the amount of load. This

[illegible] has been used extensively by the [illegible] Organization in the investigation of air defense systems. The purpose is primarily to obtain information concerning changes in the team's organization as a result of overloads. For example, they wanted to find out how the group reorganizes the task. It is also of interest to the Organization from the point of view of the team as a whole. This technique can also be used to measure the efficiency of a specific team. It may very well be that two teams that are [illegible] will [illegible] task loads may show more and more marked differences in efficiency as task load increases.

The Subtraction Method

Another method of manipulating the test situation may be labeled the subtraction method. This method varies the number of personnel available for the team. It should be noted that this variation, like the overloading, is closely related to actual operating conditions. A team faces difficulties when it has too much work to handle and also when personnel are missing. Both of these things are likely to occur under actual operating conditions.

Thus, with a fixed task load, various personnel can be subtracted from the team, and then the effect of these subtractions on the efficiency of the team can be observed. This would indicate importantly, for example, how [illegible] changeable personnel in the team really are. The number of personnel subtracted from the team can be varied. Thus it is possible to estimate the relationship of the efficiency of the team to the number of personnel available. A [illegible] refinement would involve the subtraction of various combinations of positions. All of these variations can be used to measure the basic efficiency of the team and also can be used to give general information concerning the functioning of the team.

The data from these situations could be used to set up a basis for cross-training requirements. The data could also be used to determine in a systematic manner the minimum number of personnel required by the team and the optimum.

VIII. SOME PRINCIPLES OF TEAM TRAINING

There are certain principles of training, in general, that should be applicable to the special case of team training. Some of these will be considered below:

1. Simulation

Training should take place in a situation and on an activity as similar as possible to that of the task. This principle seems obvious, but is one that is violated very frequently in the case of both individual and team training. In the case of Naval team training, obvious violations of this principle are not frequent. There are, however, violations that do occur. Although the attempt is made to have the team training situation as realistic as possible in terms of equipment, the units in which the team is trained may introduce a degree of unreality in the team situation. For example, in the case of the CIC team, there are individuals, such as the petty officers, who, by the criterion of interaction, are important members of the team. These individuals, however, are often absent from team training. In Gunnery teams the training situation differs from the actual situation in that noise is absent.

2. Feedback

Training should be adjusted according to feedback from the environment. Opportunities to obtain such feedback should be maximized. Here there is considerable deficiency, in so far as formal procedures to meet these requirements are concerned. Informally, the schools may meet this requirement by an influx of personnel with fleet experience to act as instructors. The rate of this influx, seems, however, to be variable, and marked divergences of operating and training procedures may occur. There are, furthermore, cases in which even this type of feedback via personnel is inadequate. Thus, for example, mention was made by some instructors of a period of time in which both instructors and students were aware of the fact that the procedures taught at the school were inapplicable in the fleet, and were, therefore, carried through as rote learning situations. The lack of feedback is important not only in determining what is taught, but it is also important in determining the methods of teaching and the evaluation of the teaching. The training establishments do not seem to have optimal feedback arrangements.

3. Criteria

Training should be carried out with certain over-all criteria in mind. Aside from meeting the criterion of having people present to handle all of the equipment, the goals of training may not be very clearly formulated. For example, a major problem in all Navy teams is equipment change. Especially in the case of teams like CIC, that is, teams that work with recently developed equipment, a very high rate of equipment change occurs. It would seem that in the case of such teams, some sort of goal of flexibility within the team should be considered important. Although this may be present in the minds of the individuals programming the instruction and doing the actual instruction, explicit or formal statement has not been made of such a criterion.

Throughout the course of this report the attempt has been made to apply these principles. Specific instances of difficulties in training have been discussed with them in mind, e.g., the selection problems, the "freezing" problem.

IX. CONSIDERATIONS IN TEAM CONSTRUCTION

Introduction

The purpose here is to map out in general some of the questions and principles that should be considered in the construction of teams. This area is relatively untouched by investigators. There is some relevant work done by social psychologists who have been concerned with the effects of group size and structure on the efficiency of problem solving. There is also some relevant work by economists who have been concerned with the organization of a firm. By and large, however, there is little that is directly applicable to the problems of team construction.

A question of importance is the following: "On what basis should numbers and special skills be assigned to a team?" The consideration of team arrangement usually arises after equipment has been built. At this stage, there is still some leeway in moving men and job units around. It will be assumed that the tasks called for by the equipment can be carried out comfortably and successfully by the general class of personnel expected to handle the equipment.

The Number of Men

Given the test equipment, a number of questions can be asked. First and apparently simplest is the following question: "How many men should this team have in order to carry out its functions?" The answer to this question gives rise to many complex considerations. "Is it desirable to have the smallest number of men possible within a team?" Often it is considered desirable to have a minimum number of men. This reflects certain criteria concerned with availability of man power and economy. There are certain other criteria, however, that tend to raise the number of men employed in the team.

1. Training Requirements

   For example, in the Ship Control team there are found many more members than are required to carry out the task. Many of these team members are learning in apprentice fashion the functions of the senior team members.

2. Reliability Considerations

   Another criterion that leads to the use of many rather than fewer men is reliability considerations. In cases in which errors become extremely important, there may be duplication or triplication of jobs in order to insure low error probabilities. For example, if the probability of error by a team member is p, and the probability of a correct response is 1-p, then the probability of success can be made as close to 1 as desirable, by raising the number of people

carrying out the same function. If it is assumed here that the errors are independent, then the probability of success with n members would be $1-\pi p$ (where π goes from 1 to n). If it is assumed further that the probabilities of error are the same for team members then the probability of success would be $1-p^n$.

3. Time Limits

The number of men assigned to a team also depends on the amount of time allowed for the completion of a task. The relationship is, however, not a simple one. The time to complete a job cannot in all cases be reduced by simply increasing the number of team members. This can only be done when the series of acts that make up the complete task are relatively independent. Independence means here that the sequence of the acts making up the complete task is not fixed in relation to each other. Thus, in a independent group of acts, act one may come before or after act two and act two before or after act three. For example, the sequence of acts in the Gunnery crew is highly dependent. The sequence in checking a missile is much less dependent. In the case of complete independence of acts, the team's time to complete all of the acts can be reduced to the amount of time required to complete the longest act, by increasing the number of men until there are as many team members as there are acts. In the case of extreme dependence, increasing the number of team members, whatever other advantages it gives the team, can have a relatively slight effect on the amount of time required to complete all of the acts. By definition of extreme dependence, act A must precede act B, act B must precede act C, etc.

In the above discussion, space factors must also be kept in mind in assigning team members. If space is limited, then increasing the team members beyond a certain number will be disadvantageous and will become increasingly so with greater numbers.

Requiring that an individual do two jobs instead of one involves a certain cost. Every time an individual moves from one job to another, the effect of the shift is very much like the effect of including another work unit. This becomes clearer if one considers the case in which a man has to move from one piece of equipment to another each time he changes at work. In such a case, working on equipment A and then equipment B involves at least three acts - work on A, movement from A to B, and work on B. It has been demon-

strated frequently in psychological work that shifting, even though it does not involve locomotion, can be both effortful and time consuming.

On the other hand, requiring two individuals to do the two jobs does not involve this shift-cost if the jobs are independent. If the jobs are dependent as discussed above, then there is some effort expended in communication between the two members.

Special Skills

The present basis for the assignment of personnel with special training to a team is very unclear.

The role of the highly trained man in a team causes certain problems. In examining the behavior of some of the teams sampled, it is found that most of the activity of most of the personnel, including those who are highly trained, is fairly routine in nature and does not seem to require the very advanced training. As noted earlier, the need for the highly trained man does not show itself in routine activities but appears only when a casualty occurs. For example, in a guided missile team it was discovered that the major part of the activity in routine team performance was of a relatively unskilled nature. The highly skilled personnel were needed primarily as a reserve of skill in case something went wrong. In order to fit training more accurately to the team, the amount of activity requiring advanced skills should be measured for the team.

As part of the feedback from operating teams to the schools, there should be indications of special personnel needs. For example, there were indications that certain of the guided missile teams required technicians that were not allowed for in the table of organization. This raises another important point. It may be that not only is the task equipment given, but that in addition, certain restrictions as to the task roles in a team are given. For example, there are restrictions as to the number of people with given special training to be assigned to Navy teams. With such additional restrictions, the problem of team construction becomes primarily one of distributing work load and taking advantage of cross-training.

Supervisory Structure

There is another area of importance in the construction of teams. This includes cases in which personnel restrictions are present. A key problem in this area is the following: "How many supervisors should be present within a team?" The answer to this question depends on several characteristics of the team:

1. The number of personnel within the team.

2. The average amount of activity that goes on at one time within a team. The average alone may not be sufficient in constructing the supervisory requirements of a team. Teams with widely fluctuating amounts of activity may require more supervisors than teams with the same average level of concurrent activity but little fluctuation.

3. The openness of the system to examination. This is related to the minimum number of positions necessary in order to view all of the members of the team. For example, in the Catapult team at least two positions are necessary because of physical separation of the machine room from the remainder of the team. All other things being equal, the greater the openness of the team, the fewer the number of supervisors required.

The area of supervisory structure, as well as the areas of number and training of team members have not been explored systematically. At the present time, the major recommendation is that such exploration be initiated in order to construct economical and efficient teams.

X. GENERAL RECOMMENDATIONS

There are certain paradoxical conditions existing in the team training at the schools. One of the most striking of these is the fact that the team training, although it is presumably advanced training for naval personnel, very often is spent on groups lacking the prerequisite ability or training. This point was considered in the discussion of school training above, and in the general recommendations concerning team training that follow from it. Another aspect of this neglect is found in the absence of standardized procedures for testing teams. Furthermore, in installations in which team training takes place, the testing procedures that are used do not affect in any noticeable way the future of the team. That is, a team that does very well and a team that does very poorly on an available test are not treated any differently. Both are merely returned to their respective ships.

One major factor in this neglect is in the shortage of time during the early training period for a ship. The personnel demands for the maintenance and repair of equipment is of primary concern during these early stages and very often blocks the effective use of the team training installation.

A major recommendation for team training is, therefore, that it be recognized as advanced training that involves a heavy investment of equipment, instructor personnel and trainees. This is most clearly true in the case of training for CIC teams. As such, it should have some priority assigned to it explicitly. As things stand now, this presumably advanced type of training receives teams that lack the prerequisite training. The peculiar situation in which advanced training is given to relatively unselected groups that are insufficient in number to carry out efficient training programs should at least be recognized. There is no doubt that the problem is a complex one because of the personnel demands that are in conflict. It is, however, unlikely that the team training schools work with optimal efficiency under the present conditions.

The following specific suggestions are made: (1) that the training schools have a higher degree of control over the entrance requirements for the schools, (2) that a complete system of reports on trainee and team progress be established so that the relationship between selection of team and later team performance is clarified.

An alternative to readjustment of selection procedures is to design courses primarily for the kinds of teams that do enter the schools rather than those that should enter the school. This would mean reduction of the average course level at the schools. However, training centers that deal with advanced techniques have an important role in technological improvements. This role must be weighed in considering the alternative of reducing the course level.

With reference to underway training, it is recommended that fuller use be made of it as a source of data. These data could be used for the analysis of team operations and for the construction of tests and measures for teams.

Finally, recommendations were made concerning the further exploration of the role of the following factors in the construction of effective teams: the number of team members, time requirements, the assignment of special skills, and supervisory structure.

Appendix I

CHARACTERISTICS OF EFFECTIVE AND INEFFECTIVE TEAMS

CHARACTERISTICS OF EFFECTIVE DIRECTOR CREW (GUNNERY)

	Team	Individual
Product	1. Team acquired target early and at long range.	1. Range from radar room was correct.
Behavior	1. Minimum of confusion present. 2. Men helped others when possible. 3. Men did not get rattled when something out of the ordinary happened. 4. Men had pride in ship's gunnery performance 5. Men tried to do own jobs well. 6. Men knew own jobs. 7. Standard commands were used. 8. Men knew reports they were required to make. 9. There was no confusion in phone circuits.	1. Radar operator coached trainer and pointer in correct direction. 2. Control officer assigned responsibility to pointer to get battery out when certain conditions existed. 3. Pointer kept control officer informed as to status of battery, material and personnel conditions. 4. Radar operator kept control officer informed as to solution and range of target. 5. Directing officer had pointer train a designated bearing as target was reported. 6. Pointer reported acquisition of target. 7. Talker gave mounts "air action", having them ready to fire as soon as target in range.
Cause	1. Men worked together long enough to understand each other. 2. Men liked Navy and wanted to help it. 3. All stations had been briefed on what was going to take place. 4. Men were capable of relieving any position.	1. At least one man in director (usually pointer) had complete knowledge of capabilities and limitations of battery and can operate any station in the system effectively.

CHARACTERISTICS OF EFFECTIVE DIRECTOR CREW (GUNNERY) (Cont'd)

Team

Individual

Cause

5. Men had thorough instruction.
6. Men were kept informed of situation by gun control.
7. Men were instructed in duties of other stations.
8. Practice drills involved all stations.
9. Men knew function and capabilities of equipment.

CHARACTERISTICS OF INEFFECTIVE DIRECTOR TEAM (GUNNERY)

	Team	Individual
Product	1. Team failed to acquire target. 2. Wrong information was given to gun crew. 3. Team would take no corrective action (on being informed setup was wrong), thus, missing target by 4,000 yards. 4. Team could not operate system effectively in local.	
Behavior	1. Team fired even though informed setup was wrong. 2. Crews were not alert; men sleeping while system in automatic. 3. Team did not know proper procedures for visible surface target. 4. Discipline was lax. 5. People on job didn't like it; there was lack of interest. 6. There were "short-timers" who had no interest in the ship or Navy. 7. There was a lack of respect for control officer. 8. Men did not know duties. 9. Standard procedure was not used.	1. Wrong setup was used on radar console. 2. Wrong setup was used on director. 3. Range finder operator could not take ranges. 4. Control officer was erratic. 5. Sight was adjusted to manual, preventing range coming from radar. 6. Control officer did not take complete charge of men.

(Cont'd)

CHARACTERISTICS OF INEFFECTIVE DIRECTOR TEAM (GUNNERY)

	Team	Individual
Cause	1. There was a lack of training; team was not briefed.	
	2. Team had not been drilled to use equipment in all phases of operation.	
	3. Gunnery department was not given much importance on ship.	
	4. There was a lack of supervision.	

CHARACTERISTICS OF EFFECTIVE PLOTTING ROOM TEAM (GUNNERY)

Product	Team	Individual
Behavior	1. All men had good knowledge of all stations. 2. Men were able to anticipate events in problem. 3. Men were capable of correcting errors. 4. Men were interchangeable. 5. Men knew importance of each other's job. 6. Men assisted each other in job. 7. Men respected decisions of plotting room officer.	1. Computer operator constantly checked spots applied by spot knob operator. 2. Plotting room officer knew job.
Cause	1. Men had been properly instructed in individual duties. 2. Men were instructed in duties of other stations in plot. 3. Crew was well trained. 4. All men had good knowledge of problem; had been well briefed.	1. There were FT's, gunner's mates, and storekeepers on each team.

CHARACTERISTICS OF INEFFECTIVE PLOTTING ROOM TEAM (GUNNERY)

	Team	Individual
Product		
Behavior	1. Men were slow in executing duties; had to be prompted to accomplish anything.	
	2. Men had to ask questions to find out what was going on.	
	3. Men did not check on each other; kept to own jobs and were not interested in others.	
	4. Plotting room officer got no specific answers from crew when trying to check for errors.	
	5. Men did not have confidence in plotting room officer.	
Cause	1. Many men lacked interest (short-timers).	
	2. There was a lack of knowledge of problem at hand.	
	3. There was a lack of knowledge of duties.	

CHARACTERISTICS OF EFFECTIVE GUN MOUNT TEAM (GUNNERY)

	Team	Individual
Product		
Behavior	1. Men worked together without friction. 2. Men obeyed standard commands with confidence and without question or loss of time. 3. Duties were carried out with attention to safety precautions. 4. Men did not make errors. 5. Gun didn't wave around, was at "ready air" immediately after firing. 6. There was high interest; spirit of teamwork. 7. There was confidence in every member of team. 8. Men performed necessary duties first, less important ones later. 9. Men knew own jobs. 10. Men felt loyalty and respect for mount captain. 11. Only mount captain was allowed to talk. 12. All men knew standard commands and adhered to them. 13. Men were interchangeable, could shift positions.	1. Mount captain knew all crew jobs. 2. Mount captain aided crew members to save time while firing. 3. Mount captain took action to return gun to firing in stoppages. 4. Mount captain was good leader, completely controlled personnel. 5. No unnecessary commands were given.

(Cont'd)

CHARACTERISTICS OF EFFECTIVE GUN MOUNT TEAM (GUNNERY)

	Team	Individual
Behavior	14. No excessive talking occurred among team members.	
Cause	1. Each man had specific job in preparing mount for firing.	1. Petty officer leadership was outstanding.
	2. All men were well trained.	2. Mount captain had instructed each man in his duties.
	3. Crew was not kept on GQ excessively.	
	4. There had been shipboard firing drills.	
	5. Crew understood importance of job.	
	6. Crew had pride in position and in team.	
	7. Crew tried to get higher score than other mounts.	
	8. Crew was not tired of drill.	
	9. Crew members had high morale.	
	10. Most crew members made Navy a career.	
	11. Crew members had previous experience.	

CHARACTERISTICS OF INEFFECTIVE GUN MOUNT TEAM (GUNNERY)

	Team	Individual
Product	1. Target was overhead by time mount ready to fire. 2. Gun mount was not in automatic until after plot reportec solution.	
Behavior	1. Mount crews had different interpretations of commands. 2. Live round was not removed from deck until men prompted. 3. Team was slow with S/P communications. 4. Team was slow with corrections to casualties and rate of fire. 5. Crew members had to question mount captain before carrying out job. 6. Crew members lacked confidence.	1. Mount captain didn't know duties. 2. Commands from control varied. 3. Mount captain did not instruct men properly. 4. Powderman loaded before spade dropped by gun captain. 5. Hot shellman did not catch live round as it slid out of gun, and it fell out of mount to deck. 6. Pointer and trainer failed to get on target. 7. Pointer and trainer failed to shift control to automatic. 8. Projectileman removed projectile from fuze pot and dropped it down other side of hoist. 9. Projectileman attempted to double load gun. 10. Gun captain failed to drop spade. 11. Gun captain did not have loading group under control during firing.

CHARACTERISTICS OF INEFFECTIVE GUN MOUNT TEAM (GUNNERY) (Cont'd)

	Team	Individual
Cause	1. Men were not given complete picture of exercise. 2. Many men lacked interest (short-timers). 3. Experience was lacking. 4. Proper training was lacking.	1. Petty officer leadership was poor. 2. Gunnery officer did not take job seriously. 3. Mount captain did not take job seriously.

CHARACTERISTICS OF EFFECTIVE CIC TEAM

	Team	Individual
Product	1. Conn kept informed at all times. 2. Good recommendations sent to conn voluntarily. 3. Ship's position established quickly and frequently. 4. Close liaison existed between conn and CIC at all times. 5. Maneuvering board solutions were correct and timely. 6. Plots were complete, neat and up to the minute.	1. Sound recommendations were made by evaluator on the basis of maneuvering board solutions. 2. Evaluator anticipated required action. 3. Plotting was legible to evaluator and was displayed in approved manner.
Behavior	1. Each team member exhibited knowledge of CIC function. 2. Each man had a good understanding of other stations as well as his own. 3. Each member was aware of the importance of executing duties at right time. 4. Good internal communications were maintained; phone procedure was standard. 5. Low noise level was maintained. 6. Assignment of stations carried out with little confusion. 7. Team displayed enthusiasm; morale was high.	1. The petty officer in charge of the team and the CIC officer displayed good leadership at all times. 2. CIC watch officers and leading petty officers were effective in coordinating information within the team. 3. Officer in charge was an effective evaluator; recommended course-speed changes which were clear, timely, and anticipatory. 4. Officer in charge had effective control over other personnel. 5. Evaluator and petty officer took interest in individual's contribution.

CHARACTERISTICS OF EFFECTIVE CIC TEAM (Cont'd)

	Team	Individual
Behavior	8. Individuals worked to limit of ability; members were anxious to learn.	
	9. Minimum superflous information was given.	
	10. Tactical signals were promptly and accurately handled.	
Cause	1. Petty officers and enlisted men had completed basic CIC course.	1. Officers completed basic CIC watch and air control courses.
	2. Intelligence was high.	2. CIC officer qualified as officer of the deck underway.
	3. Members required to study CIC publications.	
	4. Motivation was good; members expressed desire for naval career.	
	5. Men were experienced; team members 18 months or longer.	
	6. Shipboard training program in effect.	
	7. Enlisted men all rated except one.	
	8. Possessed knowledge of other's responsibilities.	
	9. The members of the team were well briefed and informed on all exercises conducted.	
	10. Each man paid attention in briefing.	
	11. Needed equipment was readily available and in good operating condition.	

CHARACTERISTICS OF INEFFECTIVE CIC TEAM

	Team	Individual
Product	1. Plots were sketchy. 2. Information was not circulated. 3. Few recommendations and little evaluated information were disseminated. 4. Conn and gun control were not given timely and effective assistance. 5. Communications and electronic equipment did not function properly when needed although the ship had abundance of such equipment. 6. Liaison between conn and CIC was very poor. 7. They did not evaluate and disseminate necessary data to conn; it was necessary for conn to prompt CIC for information and recommendation. 8. Equipment and plotting tools were not available and in good operating condition. 9. Signals were decoded improperly; too much time required to decode signals. 10. Plots and fixes on chart were inadequate. 11. There was no evaluation of information. 12. Conn failed to rely fully on CIC possibly because of previous inaccuracies in CIC's information and recommendations.	1. Maneuvering board solutions were inaccurate. 2. Recommendations by evaluator were delayed.

(Cont'd)

CHARACTERISTICS OF INEFFECTIVE CIC TEAM

Team

Behavior

1. The noise level was high most of the time.
2. The morale of the team was low.
3. Men exhibited "short-timers" attitudes.
4. There was no firm supervisor over the team; team was in confusion.
5. Various sections concerned with surface situation, air situation, air control, did not keep the evaluator informed.
6. Voice tubes used too much; unnecessary R/T transmissions made.
7. No leadership was present at all, with too many bypassing men-in-charge with information to conn.
8. Sound powered telephone talkers used incorrect procedure.
9. Supervision was not exercised by leading members of the team.
10. Members lacked knowledge of basic functions; used improper procedures and techniques.
11. Men were unable to use operative techniques to arrive at rapid solution.
12. Men did not understand motion resulting from maneuver.

Individual

1. Leadership of the officer and senior man in charge of the team was poor.
2. The CIC officer did not display an interest in his job.
3. The evaluator appeared unsure and relied too much on the CIC officer and the men.
4. Lack of supervision of members by leading petty officers existed.
5. Evaluator did not care what went to the bridge.
6. Disinterest was present among "short-timer" petty officers.

(Cont'd)

CHARACTERISTICS OF INEFFECTIVE CIC TEAM

		Team	Individual
Behavior	13.	Men did not know correct R/T procedure; S/P phone procedure incorrect.	
	14.	Coordination among team members lacking; individuals waited for others to do something which never happened.	
	15.	Individuals did not know responsibilities associated with jobs.	
Cause	1.	Team was not a complete general quarters or section watch CIC team.	1. Officers and petty officers did not attend instruction.
	2.	Team consisted of only one petty officer plus non-rated personnel; too few members had previous CIC experience.	2. Officer in charge had no general CIC training.
	3.	Team did not understand reason behind maneuver.	3. Officer in charge was inexperienced.
	4.	Minimum use and maintenance of CIC displays was exhibited.	4. There was a scarcity of radarman (first and chief) supervisors.
	5.	Individuals lacked ability to solve assigned problems.	5. Evaluator feared action recommended would prove incorrect.
	6.	Members did not have basic CIC training.	
	7.	Members of teams lacked knowledge of CIC fundamentals.	
	8.	Effective shipboard training program lacking.	
	9.	Individuals felt conn never used CIC information anyway.	

(Cont'd)

CHARACTERISTICS OF INEFFECTIVE CIC TEAM

	Team	Individual
Cause	10. There was a high turnover among experienced members.	
	11. Preparation and briefing lacking.	
	12. Interest on the part of supervisory team members was lacking.	
	13. Individuals were not trained in their specific duties.	
	14. Interest in job was lacking.	
	15. Upkeep of gear by maintenance personnel was poor with insufficient checking of equipment.	
	16. Organization lacked proper number of personnel, although these were available.	
	17. Team spirit was insufficient.	

CHARACTERISTICS OF EFFECTIVE NAVIGATION TEAM

	Team	Individual
Product	1. Charts were in good condition. 2. There were only minor discrepancies in training readiness problem and no discrepancies in final battle problem. 3. All necessary information was passed to interested people quickly and with a minimum of noise and confusion. 4. Commanding officer and CIC were kept informed of position regularly with recommendations where necessary.	1. Administrative inspection showed no discrepancies; there was completeness and neatness in chart correction, publications, inoperative material, current training program, and maintenance of record logs. 2. Quartermaster's notebook contained all entries for both imposed situation and actual ship movements.
Behavior	1. Individuals were coordinated - forming smooth running team. 2. Personnel familiar with equipment were assigned to department. 3. When personnel casulties occurred, others moved into position immediately. 4. Correct procedures were used in actual navigation. 5. Morale and interest were very high.	1. Navigator maintained highly accurate plot of position of ship. 2. Track was laid out on chart prior to departure.
Cause	1. Condition of bridge space was good, with all necessary publications and equipment present. 2. Charts and publications were up to date at all times.	1. Briefing on objects for navigational fixes was given to bearing talkers, recorder, plotter, and assistant plotter.

(Cont'd)

CHARACTERISTICS OF EFFECTIVE NAVIGATION TEAM

	Team	Individual
Cause	3. Excellent administrative and material conditions allowed time for training.	
	4. Time was devoted to training and preparation with daily shipboard training classes being held.	
	5. Navigation team was composed of an adequate number of personnel.	
	6. Training was capably supervised.	
	7. Shipboard training program was organized by chief quartermaster.	
	8. Previous training as a team had been provided.	

CHARACTERISTICS OF INEFFECTIVE NAVIGATION TEAM

	Team	Individual
Product	1. Records not kept properly; no azimuth record existed.	1. Insufficient recommendations were made by navigator.
	2. Compass check book was not current or accurate.	2. Logs were not kept properly; entries in quartermaster log were insufficient.
Behavior	1. Personnel were not familiar with material.	1. Helmsman did not know proper steering casualty procedure.
	2. Noise level was too high; confusion existed.	2. Only chief quartermaster knew location and use of man-overboard lights.
	3. Insufficient fixes were taken; azimuths were not taken.	3. Plotter had no assistance.
	4. No one knew what compass error was.	4. Quartermaster was not familiar with switches and equipment on bridge.
	5. Navigator was not kept informed of tactical situation.	5. Plotter had to take, record, and plot own bearings.
	6. Men lacked interest and were belligerent.	6. Plotter was late in forwarding information to conn.
	7. Equipment was not energized - fathometer, Loran, degaussing.	7. Plotter was not kept informed; had to request current tactical information.
Cause	1. Preparation was improper; no training as a team; no individual training.	1. Training of navigator and assistant navigator lacking and poor performance resulted.
	2. Personnel were not briefed prior to exercise.	2. Quartermaster of the watch paid no attention to job.
	3. Inoperative material was present.	3. Quartermaster was inadequate on logs.
	4. No deviation table or current compass check book was available for use when gyro casualty occurred.	

(Cont'd)

CHARACTERISTICS OF INEFFECTIVE NAVIGATION TEAM

	Team	Individual
Cause	5. Chief quartermaster unable to instruct and train navigation team.	

Appendix II

REPORTS ON FILE AT FLEET TRAINING GROUP

The Fleet Training Group has a file for each ship that passes through underway training. This file contains reports on completion of last and next to last training with the following enclosures:

1. Refresher Training Readiness Evaluation Report

2. Report on Battle Problem. This contains sections on Ship Control, Navigation, CIC, Communications, Electronics, Gunnery, Engineering, Damage Control, Medical.

3. ASW Readiness Report

Except for Report of Battle Problem the above are rather general.

For the last underway training, there are reports from each section of the instructional staff of the Fleet Training Group. These are of interest, since they give details concerning performance.

It should be noted that the reports listed below are not all of the reports issued by all of the sections of the school. They do indicate the general nature of the data at present available within the Fleet Training Group files.

1. Equipment Inspection Forms and Check Lists

2. Observer's Training Readiness Battle Problem Check List. The items here are primarily in terms of teams. Sample items are the following:

   a. "Did barrage rely on CIC completely for tactical signals?"

   b. "Did the officer of the deck have a clear picture of the external situation and of conditions within the ship at all times?"

3. Training Readiness Battle Problem Report. This consists of general comments and avoids specifying individuals. It is based on the check lists.

4. Memorandum Reports. These are general observations on the day's instruction and exercises. They contain comments of both a general and specific nature. Sample comments are the following:

   a. "Communications were controlled at conn."

   b. "At start of exercise officer in tactical command failed to give designation numbers."

5. Individual Exercise Evaluation Reports. These give comments on organization, preparation, individual team and equipment performance, interest displayed, cooperation.

6. Observer's Reports. These consist of check lists concerned primarily with general team information. Sample items are the following:

   a. "Was CIC liaison complete?"

   b. "Did all gun stations and CIC estimate spots?"

   c. "Are operators informed of lookout reports?"

   d. "Did CIC utilize fathometer information?"

   e. "Is the JX circuit effectively utilized in CIC?"

   f. "Is the information well coordinated within the team?"

   g. "Were all required stations manned promptly?"

   There are also items concerning individual behavior:

   a. "Does the operator know the beam width of the radar?"

   b. "Was the evaluator familiar with CIC functions?"

7. Ship's Progress Critique. This contains a rating scale concerned with personnel and equipment. It also contains recommendations concerning emphasis in training.

8. Observer's Final Battle Problem Check List

9. Observer's Report of the Battle Problem. Sample comments are the following:

   a. "The radar operator was not familiar with correct casualty procedure."

   b. "Talkers did not insure that key personnel received vital information."

   c. "Evaluation was sound and based on information available."

10. Section Head's Report on Completion of Training. This consists of general comments.

11. Compilation Sheets on Battle Problems. These are used to make up the Final Battle Problem Report. Sample comments are the following:

a. "Radar operators demonstrated correct operating and casualty control procedures."

b. "Displays adequate for evaluation and ready reference except that submarine was not dead reckoned on the geographic plot after contact was lost."

c. "Based on available combat information, evaluation and recommendations to conn were sound."

d. "The fire support mission was not passed to conn, nor was assistance given to conn by CIC in tactical maneuvering."

e. "Information from sonar was adequate, however, the organization did not provide for positive control of the ship during an urgent ASW attack.

f. "Additional training in teamwork for CIC was indicated."

g. "Equipment was not cast loose and tested."

h. "Transmission checks were not made."

i. "Shore bombardment phase was well handled."

12. Final Battle Problem Report.

11. Compilation Sheets on Battle Problems. These are used to make up the Final Battle Problem Report. Sample comments are the following:

    a. "Radar operators demonstrated correct operating and casualty control procedures."

    b. "Displays adequate for evaluation and ready reference except that submarine was not dead reckoned on the geographic plot after contact was lost."

    c. "Based on available combat information, evaluation and recommendations to conn were sound."

    d. "The fire support mission was not passed to conn, nor was assistance given to conn by CIC in tactical maneuvering."

    e. "Information from sonar was adequate, however, the organization did not provide for positive control of the ship during an urgent ASW attack.

    f. "Additional training in teamwork for CIC was indicated."

    g. "Equipment was not cast loose and tested."

    h. "Transmission checks were not made."

    i. "Shore bombardment phase was well handled."

12. Final Battle Problem Report.